THE FIELDS INSTITUTE

PUBLIC LECTURE

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Delay models for dynamic contact problems: machine tool vibrations

Machine tool vibration is one of the most intricate vibration problems which is often compared to the problem of turbulence in fluid mechanics. These vibrations cause uncomfortable noise, may damage the edges of cutting tools or certain parts of machine tools, but most importantly, they always have negative effects on the quality of the machined workpieces. These faulty surfaces present a range of hardly predictable fascinating patterns as different as those of sunflower spirals and fractal like choppy waves on stormy waters, which are a kind of fingerprints of chaotic dynamics.

The lecture summarizes the basic types of machine tool vibrations that include free, forced, self-excited, and even parametrically forced vibrations together with their different combinations. The basic concept is presented on turning processes where the idea of regenerative effect is introduced. Its relation to machined surface quality is demonstrated through an industrial case study for thread cutting. The modeling and the corresponding cutting stability of high-speed milling processes are explained and the development of the related surface quality parameters are presented. As an inverse application, surface quality based experimental methods are also introduced to identify the nonlinear characteristics of the occurring cutting forces.

Gabor Stepan is a professor of Applied Mechanics at Budapest University of Technology and Economics, member of the Hungarian (National) Academy of Sciences and the Academy of Europe (AE), associate member of the International Academy of Production Engineering (CIRP). He is holder of a European Research Council Advanced Grant (ERC AdG), he is the 2015 recipient of the Thomas K. Caughey Dynamics Award (ASME). He also served as dean of the Faculty of Mechanical Engineering at Budapest University of Technology and Economics.

Research fields include delayed dynamical systems, stability theory and nonlinear vibrations with applications in mechanical engineering, which include machine tool vibrations, wheel dynamics, force control, human and robotic balancing, traffic dynamics.

Current or former member of the editorial boards: Journal of Vibration and Control, Journal of Nonlinear Science, Philosophical Transactions of the Royal Society, Mechanism and Machine Theory, Physica D, ASME Computational and Nonlinear Dynamics, Meccanica, Nonlinear Dynamics.

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